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A Nonlethal Technique to Recover Gut Contents of Roundtail Chub

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Abstract.—Forty adult roundtail chub *Gila robusta*, captured by electrofishing from the Colorado River in Colorado, were used to evaluate a nonlethal stomach-pumping technique for recovering gut contents. Twenty roundtail chub were subjected to stomach pumping; another 20 were used as controls and not pumped. Gut contents were flushed from the anal vent instead of the buccal cavity, because the simple S-shaped gut and lack of a pyloric sphincter in roundtail chubs allowed the free passage of intestinal material. A necropsy revealed that the technique evacuated 100% of gut contents, with no apparent damage to the pharyngeal teeth, esophagus, or intestinal lining. Long-term effects were not evaluated, but no short-term ill effects were observed. This technique is recommended as a safe, efficient, and nonlethal procedure for recovering gut contents of roundtail chub. The technique may also be applicable to the endangered humpback chub *G. cypha* and bonytail chub *G. elegans*, closely-related species with nearly identical gut configurations and pharyngeal mills.

Studies of food habits are important for understanding aquatic ecosystems, but they typically require the sacrifice of large numbers of fish for stomach extraction and examination. In systems with small populations of fish, or in the case of endangered or threatened species, removal of fish may seriously deplete populations. An understanding of the food habits of the endangered humpback chub *Gila cypha* and bonytail chub *G. elegans*, species endemic to the Colorado River, is vital in identifying factors that limit their survival (Valdez and Clemmer 1982). Because it is difficult to obtain permits to sacrifice large numbers of an endangered species, a closely related species—roundtail chub *G. robusta*—was used as a surrogate to evaluate a nonlethal stomach-pumping technique. The species have similar gut configurations, mouth parts, and pharyngeal tooth structure and counts (Holden 1968). Stomach contents of a variety of species from various families—including salmonids, centrarachids, ictalurids, percids, and esocids,—have been sampled with stomach pumps, with no injury to the fish (Seaburg and Moyle 1964; Swenson and Smith 1973; Meehan and Miller 1978). Use of a stomach pump on large cyprinids, such as the endemic Colorado River chubs, has not been reported. We evaluated the efficiency of this technique and the physical effect of stomach pumping on individual fish.

Methods

The stomach pump designed and constructed for this study was based on Gengerke's modification of the original Seaburg design (Seaburg 1957; Gengerke et al. 1973). Two 50-cm lengths of flexible plastic tubing were connected to a new, hand-held, valved rubber bulb, commonly used as an in-line gasoline primer for outboard motors. The clear outlet tube was inserted into the buccal cavity of the fish, past the esophagus, and a stream of water was pumped through the tube. Food items were flushed from the digestive tract through the anal vent and into whirl-packs (Figure 1). Flexible tubing minimized the chance of damage to the esophagus and pharyngeal teeth, and the handheld rubber pump allowed for control of water flow and pressure. Tubing of 5 mm or 10 mm outside diameter was used to fit different-size fish. Two biologists performed the stomach pumping; one held the fish securely with the head tipped up and the anal vent over the whirl-pack, and the other inserted the tube in the fish and squeezed the bulb slowly to flush the gut content. Visual examination ensured careful passage of the tube past the pharyngeal teeth. The tube was inserted approximately 10 to 20 mm into the esophagus to minimize the potential for backflushing.

Tests were conducted on 40 adult roundtail chub, collected by boat electrofishing (120-V DC, 8 A, 20% pulse width, 40 pulses/s) from the mainstem Colorado River near the Colorado–Utah state line on August 5–6, 1992. Twenty randomly selected adults (mean, 279 mm total length, TL; range, 220–404 mm) were collected, pumped, and euthanized with tricane methanesulfonate (MS-222). Twenty randomly selected adults (mean, 260 mm TL; range, 219–347 mm) were used as the control group; they were handled in the same manner as the test group, but not subjected to stomach pumping. Each fish was measured for weight and length before treatment.

The head of each euthanized fish (test and con-

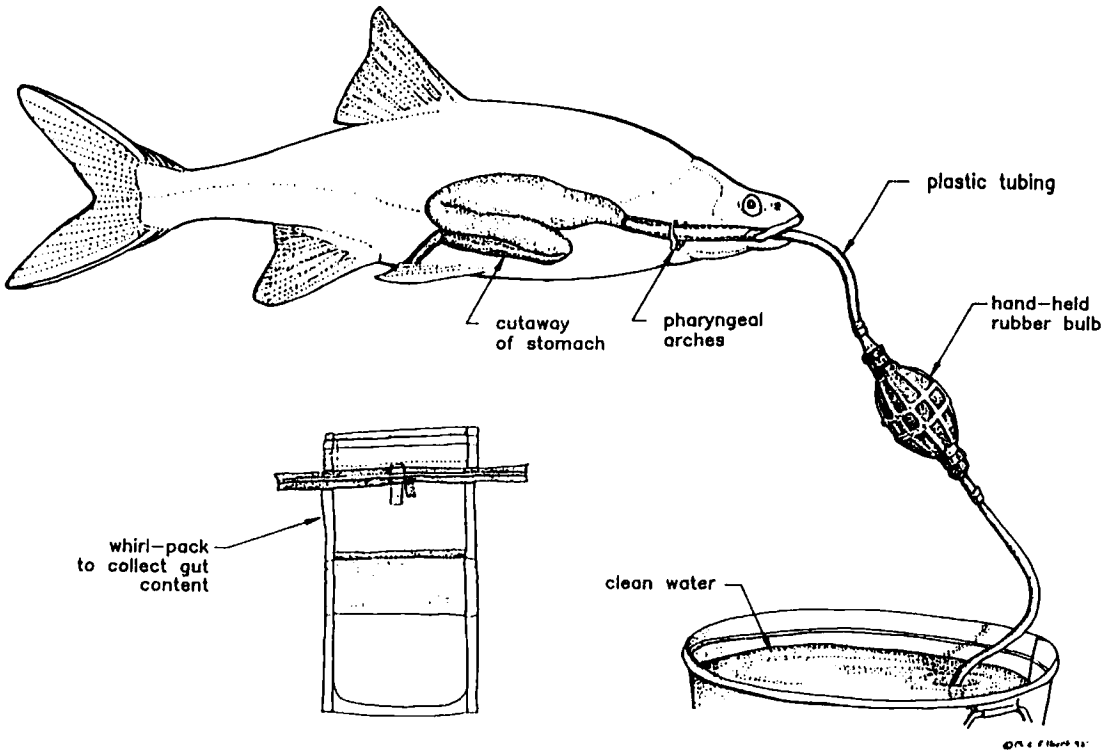

FIGURE 1.—Stomach-pumping apparatus applied to a roundtail chub.

trol) was dissected with a sharp pair of scissors to examine the esophagus and pharyngeal teeth. The first cut was made longitudinally through the dorsal aspect of the cranium, from the tip of the maxillary to the posterior end of the cranium. A second cut was made transverse to the first, extending circumventrally to the base of the gill arches. Care was taken to avoid damage to the gill arches, pharyngeal arches, or esophagus, and photographs were taken to document their condition. To evaluate damage inflicted by the stomach pump, the teeth of each pharyngeal arch were counted, examined for alignment, and inspected for loosening or breakage in both test and control fish.

The volume of flushed gut contents from each test fish was measured in a graduated cylinder. After the pharyngeals were examined, the entire gut of the individual was removed and dissected, and the volume of residual remains was measured. Stomach pump efficiency was expressed as the percentage (by volume) of food items recovered from the fish by stomach pumping.

Results and Discussion

Of 20 adult roundtail chub subjected to stomach pumping, measurable amounts of food were flushed from eight, whereas eight others yielded only traces of algae or unidentifiable debris, and four contained no food. Most of the flushed material was insects, some mixed with algae. This stomach-pumping technique was 100% efficient, based on an examination of residual gut contents after flushing.

In all cases, gut contents were flushed from the anal vent instead of the buccal cavity, as reported by all investigators for other fish species (Seaburg and Moyle 1964; Swenson and Smith 1973; Meehan and Miller 1978). The presence of a simple, S-shaped intestine and the absence of a pyloric sphincter in the genus *Gila* precluded the development of backpressure to force stomach contents through the mouth. Material from the gut was evacuated from the vent with relatively little water pressure, which suggests that there was little physical stress to the intestine and intestinal lining. Visual examination of the entire gut tract showed no noticeable signs of lesions, contusions, or other deformations.

No evidence of broken or damaged pharyngeal teeth was found in the fish subjected to stomach pumping. Seven control fish and nine test fish were found to have loose pharyngeal teeth. Pharyngeal

teeth of cyprinids are shed and replaced continuously (Harder 1975). All loose pharyngeal teeth of both test and control fish appeared to be in the process of ankylosis, the anchoring of a new tooth, based on the presence of tooth buds or emerging teeth within the pharyngeal epithelium, adjacent to the existing tooth on the pharyngeal arch. The growth of tooth buds constricts the blood vessels leading to the pulp of the existing tooth, causing it to atrophy and shed (Harder 1975). Thus, the loose teeth were probably the result of natural shedding rather than the result of the stomach-pumping technique. As a qualitative test, we purposely attempted to break or loosen individual teeth of several sacrificed fish with a knife blade. A tooth could be broken, but not loosened, and great force was required to damage the tooth, much greater than could be inflicted by a small plastic tube. Although permanent damage to pharyngeal teeth could result in impairment of feeding and represent a serious threat to the welfare of the fish, this stomach-pumping technique is not likely to cause this degree of damage, and any damaged teeth would probably be replaced because of their deciduous nature.

Although the fish were not held for an extended time period, the absence of visible damage to the gut tract and pharyngeal mill of test fish, and the lack of stress or disorientation of the fish following pumping suggested that no long-term ill effects would results from this procedure. The anesthetic MS-222 was used only to euthanize the fish after testing, not to sedate them prior to stomach pumping. Roundtail chub were relatively docile during stomach pumping, which eliminated the need for an anesthetic. This suggests that an anesthetic may not be needed for other chub species.

The described stomach-pumping technique is recommended for use with adults of the endangered *Gila cypha* and *G. elegans*. The procedure should be performed as described. It is advised that only light pressure on the bulb be used to evacuate gut contents. Because material is being flushed through the entire intestinal tract and out the anal vent, a bolus of algae or large food item could cause intestinal blockage that, if forced, could injure the fish. If no food is evacuated with two or three gentle flushes, the procedure should be halted and the fish released. If carefully used, this technique is also expected to be a safe, efficient, nonlethal method for recovering gut contents of Colorado River chubs, because these species primarily consume insects and small organic debris that are easily flushed from the intestine.

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